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AIRPOWER'S MASTER TENANT AND ANTI-ACCESS/AREA DENIAL: HOPE IS NOT A COURSE OF ACTION

by

William Betts, Lt Col, USAF

A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

Advisor: Mr. Harry Foster

13 February 2014

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Biography

Lt Col William Betts graduated from the United States Air Force Academy in 1995. He flew the F-16CJ and CG for 16 years until he was selected to the initial cadre for the F-35 in 2010. Lt Col Betts is a graduate and former instructor at the United States Air Force Weapons School. His Operational experience includes Operations Northern Watch, Southern Watch and Iraqi Freedom.

Abstract

Two decades of conflict in the Middle East have shaped the USAF's cultural habits for a specific type of enemy: one who has offered minimal opposition to air, space, and cyber supremacy. The nature of these conflicts has encouraged a creeping centralization of command and control (C2). This shift has been out of convenience. Emerging peer competitors signal the need to decentralize out of necessity. This paper argues that unless the USAF leads a doctrinal shift to centralized command, adaptive control, and decentralized execution, it will suffer increasing paralysis due to A2/AD lines of operation specifically designed to exploit today's centralized control paradigm.

In the near future, technological peers will be focused on hitting the USAF where it hurts most. The A2/AD focus on C2 denial portends a formidable challenge to U.S. C2. These changes in the character of war, coupled with a shrinking U.S. defense budget will require adaptive control. USAF culture is well suited for centralization, but a rebalance toward decentralization will be necessary to employ this model.

In addition to bolstering our communication and network security, the USAF should use the C2 concepts presented in this paper to commit to the mission command philosophy instead of maintaining the hope that a technophile, brute-force network defense will hold against a technological peer. Hope is not a course of action.

Introduction

> Like the French military which relied upon climbing out of the trenches at Verdun to win World War One and hoped that the next war would be carried out the same at the Maginot Line, the American military which won a victory in the Gulf War also hopes to continue the "Desert Storm" type addiction during the 21st century…It was little imagined that the blind spot in the visual field of the Americans would just appear [as blind faith in technology to solve all political problems]. [1]
>
> *Unrestricted Warfare* – published in China in 1999

The USAF is a large craft with a small rudder. Changing its culture and norms is difficult and requires time. Two decades of unopposed air, space and cyber operations in the Middle East have inbred habits ill-suited for an opposed environment.[2] Of particular concern is the centralization of command and control (C2) processes that has crept into doctrinal thinking over the past two decades.[3] Now that Iraq and Afghanistan are winding down, the USAF must reexamine its master tenet of "centralized control, decentralized execution" and determine whether it is, indeed, appropriate for the emerging Anti-access Area Denial (A2/AD) military-technical competition in the Pacific.

Initial attempts to address A2/AD, such as the Department of Defense's 2012 Joint Operational Access Concept (JOAC), recognize that the cross-domain synergy so crucial for countering A2/AD methods will place "a heavy burden on command and control"[4] while facing the disruption of space and cyber.[5] The JOAC plans to cope via decentralized C2 in the form of mission command.[6] The USAF is behind. Even the most recent Air Force Doctrine Document 1 encourages centralization.[7]

The centralization trend was driven by the convenience of unopposed operations. Looking ahead to 2040, however, it will soon be time to decentralize out of necessity as the US enters a military-technical competition with China. Unless the USAF leads a doctrinal shift to

the mission command philosophy, it will suffer increasing paralysis from A2/AD lines of operation specifically designed to exploit today's centralized control paradigm.

This paper begins by identifying elemental determinants for balancing centralization and decentralization. Next, it shows how a peer competitor and A2AD are at odds with the master tenet. Finally, it recommends course corrections that must be applied now in order to have the USAF on track by 2040.

Thesis

Unless the USAF leads a doctrinal shift to the mission command philosophy, it will suffer increasing paralysis from A2/AD lines of operation specifically designed to exploit today's centralized control paradigm.

Elemental Determinants of Centralization/Decentralization Balance

Joint publication 3-30 states, "Joint Air Operations are normally conducted using centralized control and decentralized execution."[8] Some authors refer to this as the master tenet of airpower.[9] In *Command of War*, Martin van Creveld argues that centralization and decentralization "are not so much opposed to each other as perversely interlocking."[10] Greater centralization decreases flexibility for subordinates and slows response time. Conversely, decentralization increases flexibility at the tactical level. Such delegation of authority may limit the commander's options at the operational level, however.[11] The art of airpower C2 is striking the appropriate balance between centralization and decentralization. To understand how this balance is achieved operationally, some doctrinal definitions are useful.

Doctrinal C2 Definitions

Command can be an authority, order, or organization.[12] Control is a broad concept that Hinote calls the root of confusion among senior officers and line Airmen alike.[13] The definition of "command and control" in Figure 1 is helpful contextually. Paraphrased, C2 is the exercise of authority and direction. Command is the authority and control is the direction. Stanton, Baber, and Harris agree with this distinction, defining command as the authority and control as the means to assert this authority for the accomplishment of the mission.[14] Alberts goes further, stating that control determines "whether current and/or planned efforts are on track. If adjustments are required, the function of control is to make these adjustments if they are within the guidelines established by command."[15] Execution, then, is carrying out the plan within the boundaries of the direction from the empowered control elements.

command — 1. The authority that a commander in the armed forces lawfully exercises over subordinates by virtue of rank or assignment. 2. An order given by a commander; that is, the will of the commander expressed for the purpose of bringing about a particular action. 3. A unit or units, an organization, or an area under the command of one individual. (JP 1)

command and control — The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Also called **C2.** (JP 1)

control — 1. Authority that may be less than full command exercised by a commander over part of the activities of subordinate or other organizations

centralized control — 1. In air defense, the control mode whereby a higher echelon makes direct target assignments to fire units. (JP 3-01) 2. In joint air operations, placing within one commander the responsibility and authority for planning, directing, and coordinating a military operation or group/category of operations.

decentralized control — In air defense, the normal mode whereby a higher echelon monitors unit actions, making direct target assignments to units only when necessary to ensure proper fire distribution or to prevent engagement of friendly aircraft. (JP 3-01)

decentralized execution — Delegation of execution authority to subordinate commanders. (JP 3-30)

Figure 1: Doctrinal Command and Control Definitions[16]

Because it is the commander who empowers, Airmen seem to accept an ambiguous boundary between the concepts of "command" and "control." The confusing border lies between control and execution. Marzolf makes the point, "a subordinate commander's 'execution authority' includes some degree of control. For if they could not control, they could not direct assets to overcome enemy actions—their sole purpose for existing."[17] When the enemy offers no opposition to air, space, and cyber, it is easy to forget that execution, under different circumstances, requires a higher degree of control. The doctrine supporting air defense and their treatment of control in networked and non-networked modes illustrate this point.

Battle Networks and Their Impact on Control in Air Defense

There are three modes of control in U.S. air defense vernacular. **Centralized control** is used when conditions require a higher echelon to authorize each and every target engagement. Units operate under **decentralized control** when "a higher echelon monitors unit actions, making direct target assignments on a management by exception basis."[18] When special instructions permit, the unit commander initiates **autonomous operations** when his firing unit loses communications to the headquarters. In this extreme form of decentralization, the on-site commander assumes full responsibility for control of weapons and engagement.[19] Air defense units have the tools, training, and doctrine to rapidly flex between the three modes. As threats to C2 systems emerge, the ability to adapt to varying degrees of control should be a guiding principle. Three additional concepts help explain the way forward.

The overlap of *Depth of Command* and *Height of Execution* enable *Adaptive Control*

Because there is no "one-size fits all" C2 structure, some strategists have called for the adoption of "adaptive control," providing the commander rule-based mechanisms to delegate control authorities to various levels in order to optimally centralize or decentralize air

operations.[20] Stanton, Baber, and Harris add, "centralization/decentralization does not appear to change the 'process' merely the 'ownership' of the process elements."[21] Under certain circumstances, it is helpful to delegate ownership of higher level control processes to lower level subordinates. ***Depth of command*** and ***height of execution*** help explain how the *potential* to centralize *and* decentralize control must be in place to enable ***adaptive control***.

During the Cold War, both U.S. and Soviet forces found that commanders tended to centralize decision making as their battlefield communications improved.[22] The potential to competently control subordinate actions far down the chain of command is what Kometer termed *depth of command*.[23] The more control processes the command element has the capability to own, the greater the *depth of command.* See Figure 2 for a visual depiction.

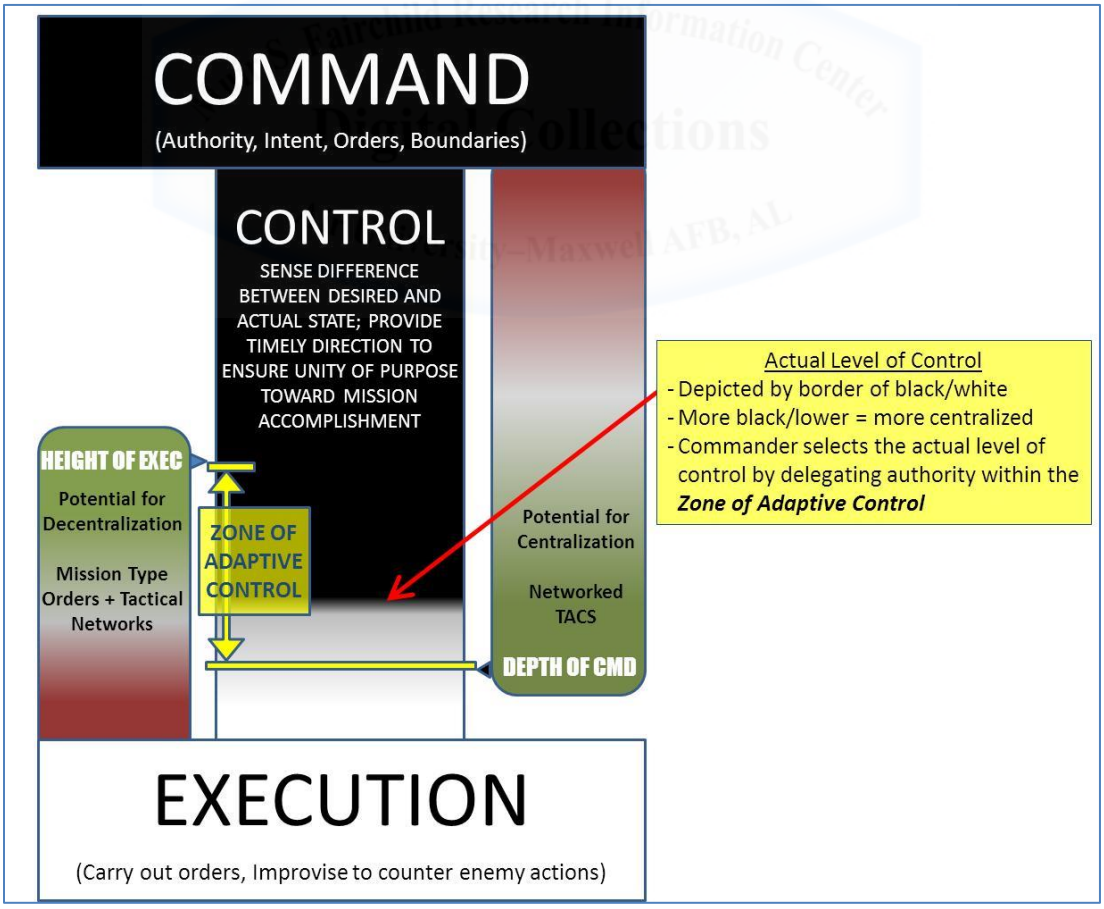

Figure 2: Depiction of Key C2 Concepts

Conversely, ***height of execution*** extends from the bottom-up. It measures the potential for the commander to decentralize control. Control is most adaptive when both the top (command /operational level) and the bottom (execution/tactical level) have the capability to take ownership of the same control processes. The overlap of the ***depth of command*** and ***height of execution*** is the ***adaptive control zone***, depicted by the yellow arrow in Figure 2. The commander selects the actual level of control (depicted in Figure 2 by the white/black border) by delegating authority within this zone. A lower border equates to greater centralization. If the commander sets the level of control below the ***depth of command***, he is taking responsibility for processes that he cannot control. If the level of control is set above the ***height of execution***, a responsibility/capability gap exists: the commander is asking subordinates to own processes that are beyond their capability.[24] The elemental determinants in the next section not only help the Air Force organize and equip the force by highlighting responsibility/capability gaps, but they also guide commanders in making real-time reassignment of authorities to ensure the appropriate level of control under rapidly changing conditions.

A Search For Elemental Determinants of the Centralization/Decentralization Balance

Developing a tool to understand the balance between centralization and decentralization begins by sketching some basic elements of operational art for air planners. No paper in the recent literature does this better than Hinote's *Centralized Control Decentralized Execution: A Catchphrase in Crisis*. Hinote proposes five key questions for determining the appropriate centralization balance summarized in Figure 3.[25]

Hinote's Five Questions to Balance Centralization/Decentralization

1. What is the nature of the operation?
   - Strategic attack = centralization, Close Air Support = decentralization
2. Where should flexibility be preserved?
   - Nuclear ops designed to preserve flexibility at strategic level
   - When tactical actions can lead to political consequences, Centralization is appropriate
3. How many assets are available?
   - If Joint Force Commander had unlimited assets, there is no need to centralize
4. What is the geographical range of effects
   - Can assets flex from area to area (i.e., long range bombers, cyber attacks)
5. Who has the best situational awareness
   - Air engagements = Air Battle Manager; Time Sensitive Targeting = Air Ops Center

Figure 3: Hinote's Five Questions to Balance Centralization/Decentralization

Hinote's questions are, by design, focused on resolving C2 challenges in the last two decades of conflict in the Middle East. Consequently, his discussion of the centralization/decentralization balance focuses on "what does U.S. capability enable?" rather than "what does enemy capability deny?" As A2/AD threats intensify, the latter question is likely to overtake the former. Such a possibility highlights the need to decompose the foundational assumptions of the master tenet into its elemental determinants that are free from historical biases and account for future capabilities and peer competition.

Table 1 provides a list of the elemental determinants that determine the degree of centralized on decentralized control derived from Hintoe's questions and other scholarship. Understanding each of these areas provides the foundation for further analysis of the problem.

Table 1: Summary of Elemental Determinants

Elemental Determinant	Result of More (+)	Result of Less (-)
1. Time Available in Decision Cycle	**Enables** Centralization	**Forces** Decentralization
2. Bandwidth (Comm/Data)	**Enables** Centralization	**Forces** Decentralization
3. Geographic Range of Effects	**Enables** Centralization	**Forces** Decentralization
4. Scarcity of Platforms	**Forces** Centralization	**Enables** Decentralization
5. Need for Higher Level Synchronization	**Forces** Centralization	**Enables** Decentralization
6. Sensitivity to Unintended Consequences	**Forces** Centralization	**Enables** Decentralization
7. Mistrust of Subordinate Process Ownership (Sit. Awareness, Competence, Initiative)	**Forces** Centralization	**Enables** Decentralization

Time Available in the decision cycle. Colonel John Boyd provides the first elemental determinant. In his "Organic Command and Control" briefing, Boyd's key idea is to "gain a favorable mismatch in friction and time (i.e, ours lower than any adversary)."[26]

Bandwidth (Communications/Data). Alberts and Hayes argue two factors for determining the correct C2 approach include continuity of communication and quality and volume of information across echelon and function.[27] The second elemental determinant combines these two factors into "Bandwith (Communications/Data)". More bandwidth enables centralization by allowing continuity of communication across echelons. While less bandwidth forces decentralization since command elements can no longer provide direction to subordinates.

Geographic Range of Effects. Some platforms, such as bombers, RPAs and tankers, and effects, such as space-based ISR and cyber, can easily flex from one geographic area to another. A key lesson for the senior airmen from World War Two (WWII) involved decentralizing air assets in the form of "penny packets" assigned to individual ground commanders. Although this practice assured that each unit always had some small amount of airpower on hand, it did not make use of the aircraft's ability to quickly transfer from one area to another.[28] In short, penny packing constrained air power's inherent flexibility to mass forces quickly at a single point at

critical times. This was the origin behind "centrally controlling" air operations under one airman who understood its unique range of effects. An increase in this determinant enables centralization, while a decrease forces decentralization. Force developers control some aspects such as combat radius and tanker availability, but theater dimensions also play a part. For example, platforms supporting contemporary conflicts in CENTCOM have the range to reach multiple operations. This enabled the Joint Force Air Component Commander to direct assets to the highest priority.

Scarcity of Platforms. Hinote phrased this concept in the question "how many platforms are available?" This is closely related to "geographic range of effects." If the platforms and effects were unlimited, each unit in the WWII example above could have an abundance of platforms, and there would be no need to prioritize them through greater centralization.[29] Hinote asserts, "fewer assets drive the need for more centralization—specifically, centralized apportionment."[30] Less platforms (more scarcity) forces centralization, while more platforms (less scarcity) enable decentralization.

Need for Higher Level Synchronization. Hintoe's first question asks, "What is the nature of the operation?" Although this is a question every commander should ask, more specific guidance would be helpful. Hinote argues strategic attack requires centralized control in order to provide synchronization.[31] Although this is true up to this point in history, the technology of 2040 may not require multiple platforms or effects for a strategic attack mission; or the elements may have the ability to self-synchronize. Instead of linking the C2 model to mission types whose character may change in 2040, it seems more appropriate to ask, "What is the need for higher level synchronization?" A greater need forces centralization, while a reduced need enables decentralization.

Sensitivity to Unintended Consequences. In his discussion of question two, Hinote states that centralization is appropriate when tactical actions threaten to generate political consequences.[32] This concept became the sixth elemental determinant "sensitivity to unintended consequences." More concern for unintended consequences forces centralization while less concern enables decentralization.

Mistrust of Subordinate Process Ownership. Hinote's fifth question begs commanders to ask "who has the most situational awareness (SA)," implying that the level with the most SA will make the best decision.[33] Alberts and Hayes point out additional factors that play into decision making, including competence, creativity, and initiative.[34] The seventh elemental determinant combined these ideas into "mistrust of subordinate decisions." When the commander cannot trust his subordinates with broader authority and process ownership, he is forced to centralize control. Conversely, more trust enables decentralization.

Relationships of the Elemental Determinants and Impact on Adaptive Control

At this point, three concepts are important to grasp from Table 1. First, while changes in some determinants may give the commander the option to centralize or decentralize, others force his hand. Second the potential for centralization (***depth of command)*** increases with greater time, bandwidth and/or geographic range of effects (items 1-3 in Table 1). Finally, planners can maximize the potential for decentralization (***height of execution)*** when there are more platforms, fewer requirements for higher- level synchronization, less sensitivity to unintended consequences (such as collateral damage), and trust in subordinates is high. Figure 4 depicts these relationships and their impact on the C2 concepts from Figure 2.

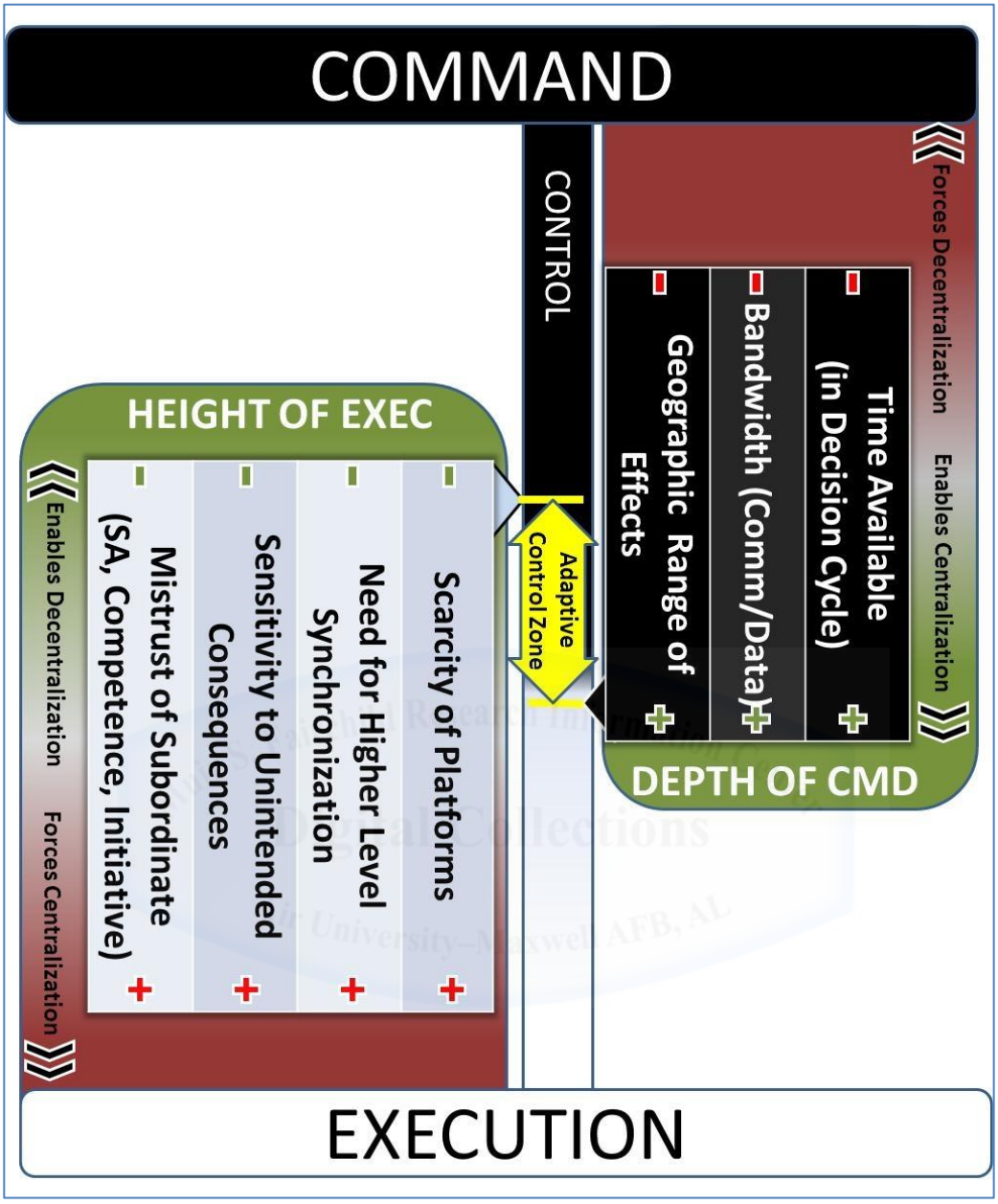

Figure 4: Effect of Elemental Determinants on Adaptive Control

This figure is not meant to be an all-inclusive Jominian checklist, but more in the spirit of Hinote's five question "art lesson." For example, if time available increases (moves in the direction of the plus sign) due to the enemy's slower C2 response time, centralization is *enabled*, because the inherent decision-making delays are acceptable. However, if time-available decreases, C2 is *forced* to de-centralize to match the enemy's tempo. Also note that the ***adaptive***

control zone is maximized when ***height of execution*** is tallest, and ***depth of command*** is deepest.

A review of literature finds the nature of the conflicts in Iraq and Afghanistan since 1990 has encouraged greater centralization of air, space, and cyber power.[35] A quick assessment of the elemental determinants, in order, demonstrates this trend (see

Figure 5**Error! Reference source not found.**). First, minimal threats to air operations allow tactical elements to re-role into un-briefed missions/areas and maintain a rapid operations tempo, resulting in more "time available in the decision cycle." Second, an unopposed space/cyber/environment permits ubiquitous communications or "greater bandwidth." In addition, adjacent theaters and unopposed tanker orbits allowed many platforms to flex from one geographic area to the next on a daily basis resulting in a "greater range of effects."

The operational environment drove the increase of these first three determinants, enabling centralization. The service culture followed this shift with determinants four through seven. The USAF's propensity for quality over quantity, compounded by a shrinking budget, continues to increase the "scarcity of platforms" that are suited to a contested environment.[36] Targeting high value individuals required cueing from national assets through a centralized ISR hub in a distant headquarters (more "higher-level synchronization" required).[37] Finally, winning hearts and minds in a battle for the narrative meant that a single errant weapon had strategic effects. This not only increased the "sensitivity to unintended consequences," but also necessitated strict rules of engagement that conditioned operators to ask permission before taking action. As a result, "mistrust of subordinates" increased due to a lack of initiative.[38] Centralization of expertise such as weaponeering further eroded subordinate element's capacity for process ownership,[39] another hit to the "mistrust in subordinates" determinant. Figure 5 depicts the result: a present day

service culture wedded to centralized control. There is an adequate adaptive control zone because the considerable ***depth of command*** makes up for a short ***height of execution***.

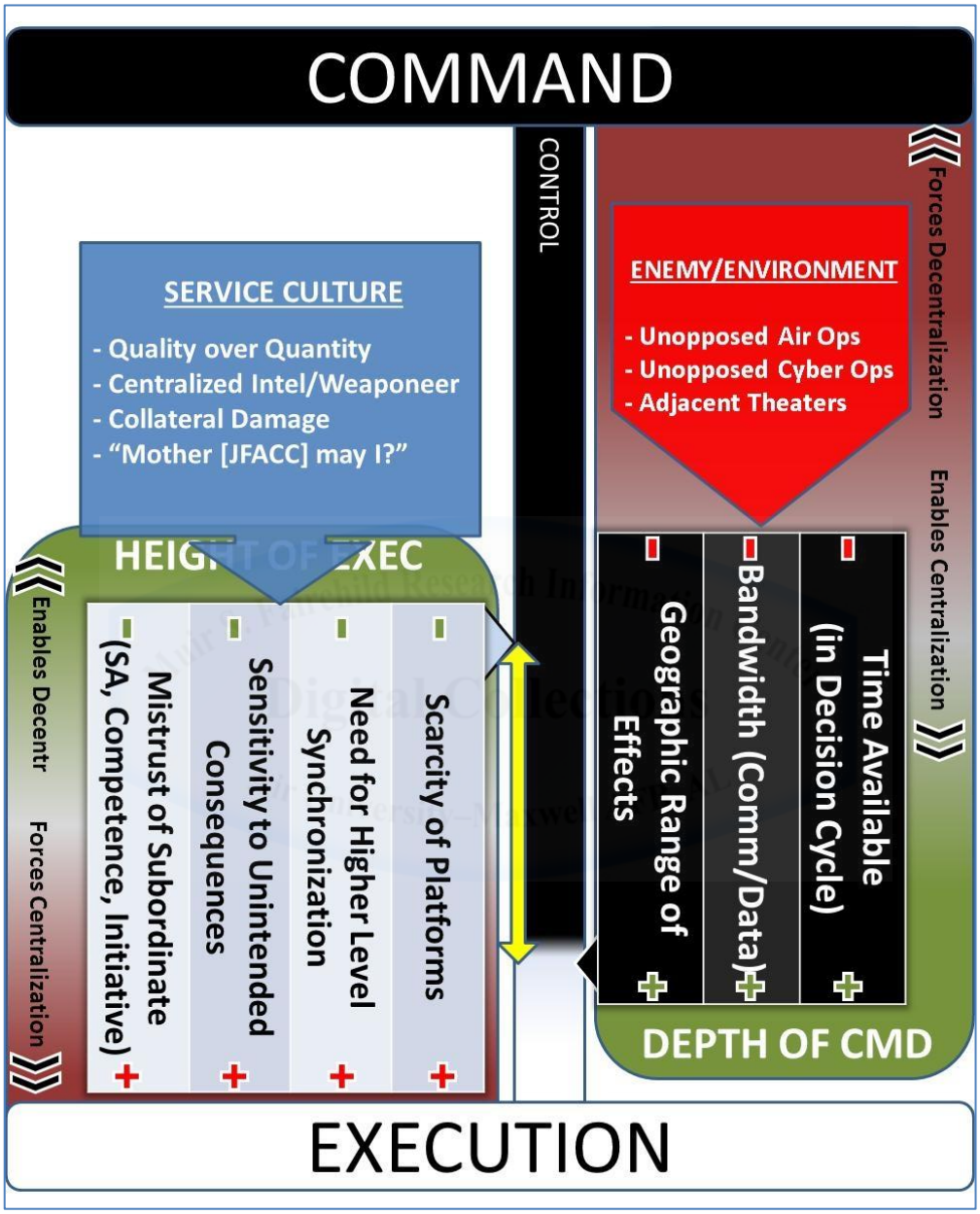

Figure 5: Present Day USAF C2 Paradigm of Centralized Control.

Centralized control can be appropriate if your enemy permits it. However, a peer competitor in the Asia-Pacific in 2040 will challenge the Airman's belief in the master tenet. The next section

demonstrates how the A2/AD lines of operation in the Asia-Pacific instantly reduce the ***depth of command***, erase the ***adaptive control zone***, and create a responsibility/capability gap.

Future Peer in Asia-Pacific Forces Decentralized Control

The U.S. is accustomed to having a technological advantage that allows brute force defense of bandwidth through space, cyberspace, and the electromagnetic (EM) spectrum. Emerging technological peers will challenge that presumption through cyber disruption,[40] space denial,[41] and autonomy.[42] Unless the USAF leads a rebalance to decentralization, operations in the Asia-Pacific will be vulnerable to A2/AD lines of operation that specifically disable the centralized control paradigm.

Table 2 summarizes the A2/AD lines of operation. These concepts, combined with the nature of the Asia-Pacific operational environment, challenge the present day C2 paradigm as illustrated in Figure 6. For example, China's interior line advantages, such as the use of closed network fiber optic communications, increase the resiliency of their command and control networks, while U.S. dependence on open-air use of the EM spectrum creates a vulnerability. The effect is a decrease in U.S. "bandwidth." Another environmental trait is the geographic vastness of the Pacific Ocean and the dearth of suitable bases for U.S. operations. This, combined with lines one and two of China's A2/AD strategy, affect several of the elemental determinants. "Scarcity of platforms" is amplified because of the difficulty in getting assets (air and sea) into theater and a lack of runways and ramp space.[43]

Table 2: Antiaccess/Area-denial Lines of Operation[44]

Line of Operation	Objective	Capability
1. Disrupt blue airbases	Slow force closure, deny air refueling, deny sensor and weapons density	Air, guided rocket, artillery, mortars, missiles, submarine, special operations
2. Deny sea approaches	Deny carrier approach, deny sensor and weapons density	Missile, submarine, small boat swarm
3. Deny/disrupt sea logistics	Deny operations	Special operations, air, missile, submarine
4. Disrupt space surveillance	Reduce sensor density	Ground- or space-based
5. Deny persistent intelligence, surveillance, and reconnaissance, and strike	Reduce/deny sensor and weapons density	Integrated air defenses, fighter forces, electronic warfare, cyber, counterspace
6. Decoy, deceive	Reduce sensor and weapons density	Physical and cyber means
7. Immunize against attack	Deny U.S. military objectives	Bury, harden, disperse
8. Deny command and control/ networked communications	Deny or confuse operations	Cyber/electronic warfare

"Geographic range of effects" is diminished because of the distances involved and the vulnerability of tankers to advanced air defenses. Situational awareness (and therefore trust in subordinates) is degraded because A2/AD lines six and seven necessitate a hunt for mobile needles in a haystack and line five denies the persistent ISR to search. These factors act together to lock in China's A2/AD advantage. With these systemic effects in mind, the reader should appreciate three key lessons from **Error! Reference source not found.**. First, the determinants affecting *depth of command* can turn on a dime with new environments and enemy capabilities. Second, the shallow ***depth of command*** eliminates the ***adaptive control zone*** and creates a responsibility/capability gap (note the orange rectangle). Because the level of control is *forced* above the ***height of execution***, there are now owner-less processes such as theater-wide scheduling, weaponeering, and ISR fusion.

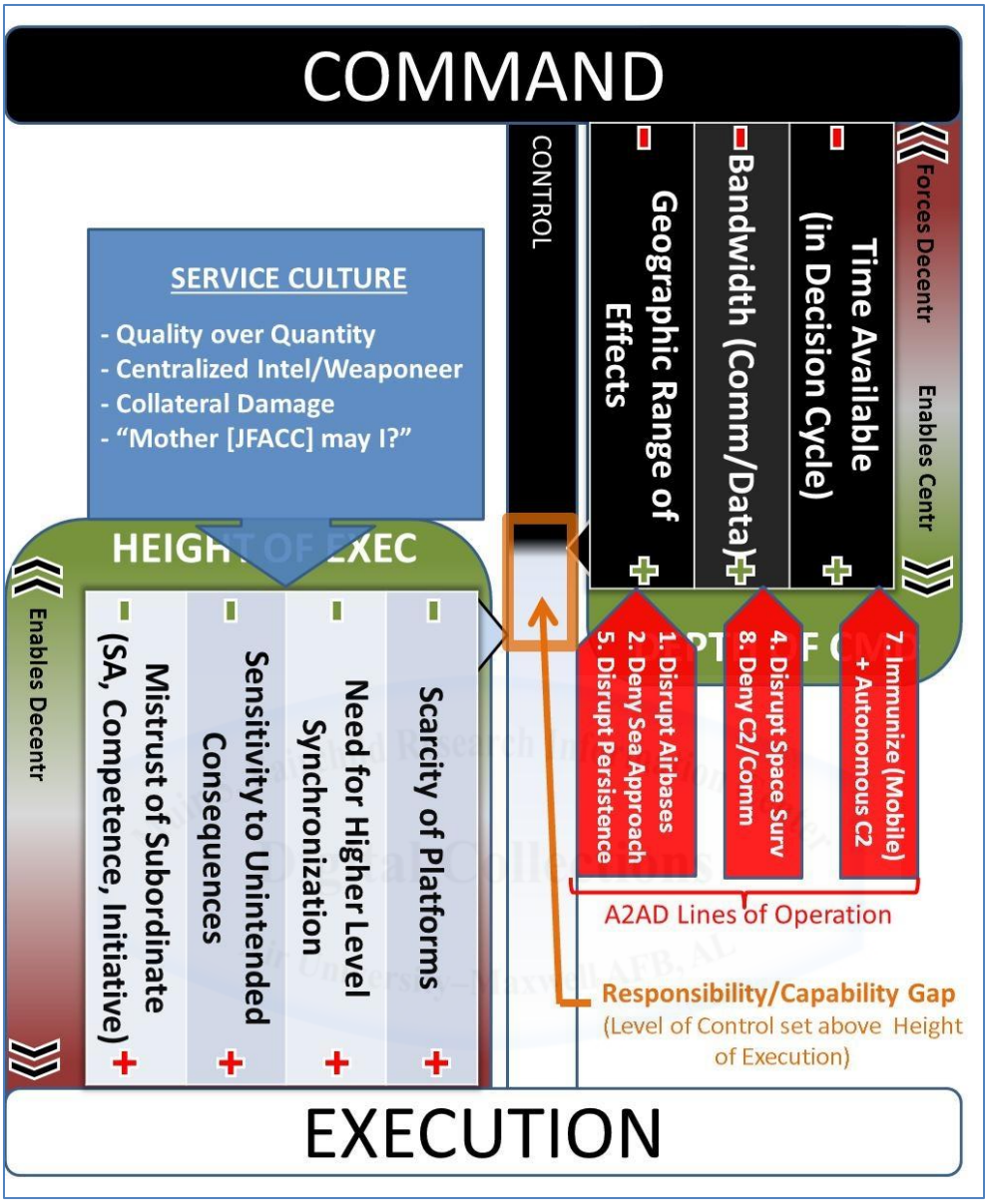

Figure 6: Service Culture at Odds with A2/AD

These processes cannot be centralized because of bandwidth disruption, and they cannot be decentralized because the lower levels were never empowered with the requisite tools or training. Finally, there are only two ways to correct the gap. First, gain back the time, bandwidth, and range of effects – a tall order against a technological peer focused on denying them. Second, shift the determinants that enable ***height of execution***. The second option shifts in acquisitions and service culture requiring two decades to achieve. It's time to start now.

Recommendations

Unquestionably, the joint force should defend its bandwidth in an attempt to maintain ***depth of command***. This is well recognized and these efforts are underway in the form of wireless mesh networks,[45] laser communications, and quantum encryption.[46] Development of hypersonic vehicles and long-range global strike already seek to improve "geographic range of effects."[47] The dire need lies in improving ***height of execution*** with a new service culture based on mission type orders and resiliency as depicted in Figure 7.

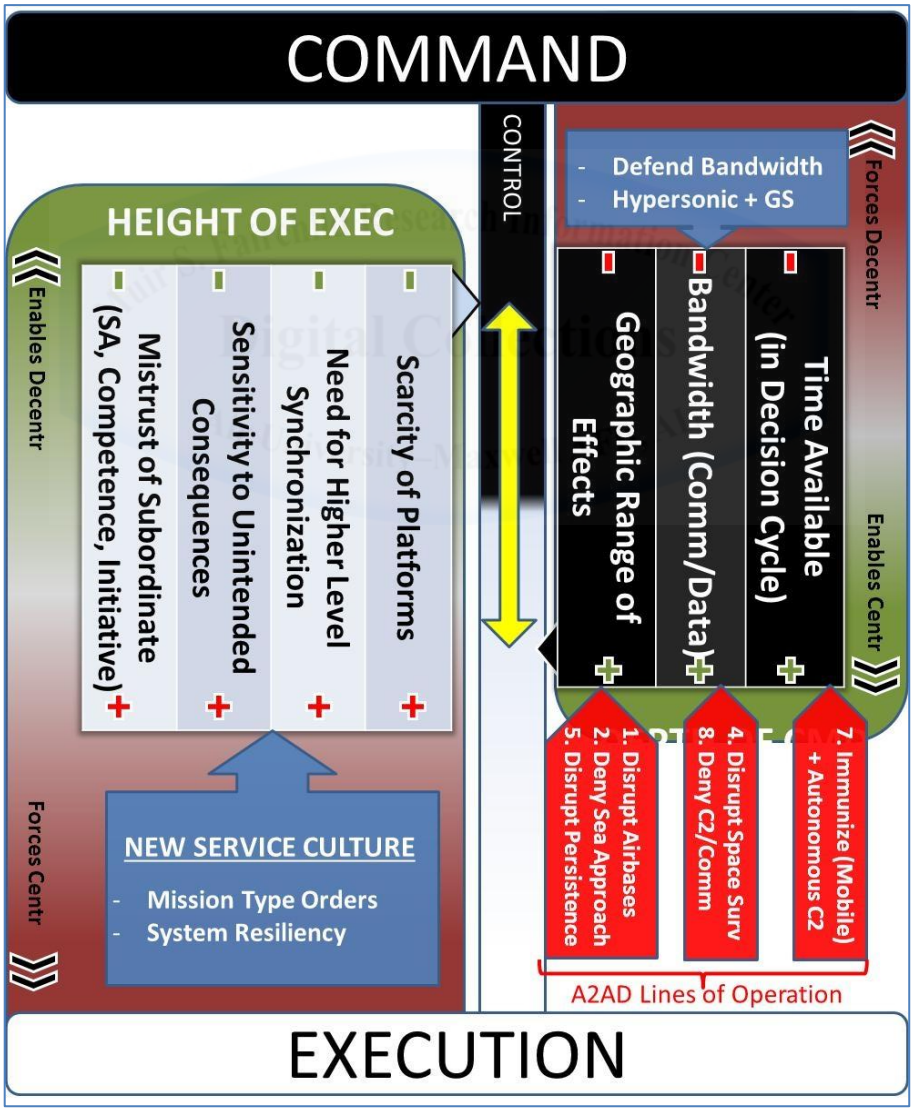

Figure 7: New Service Culture Enables Adaptive Control

Although China leads the way, the A2/AD approach has undeniable appeal for any developing country seeking to gain leverage against a superior military foe. Consequently, it has the potential for wide proliferation similar to Mao's insurgency model. Such opposition will become more likely as time passes, and the USAF should recognize this challenge as the rule, rather than the exception. If network defense fails, the tactical level must already possess the tools and training necessary for decentralized control. The C2 rebalance depicted in **Error! Reference source not found.** requires a shift away from brute force defense of centralization and toward a culture of decentralization enabled by mission type orders and system resiliency. In stark contrast to the present day paradigm (

Figure 5), A2/AD forces the USAF to raise the ***height of execution*** to make up for a shallow ***depth of command.*** The following recommendations chart the course with one correction for the near-term, one vision for the medium-term, and one approach to guide long-term force development.

Near Term: A New Master Tenant for Centralized Command, Adaptive Control, Decentralized Execution.

The first recommendation carries forward Marzolf's call for doctrinal acceptance of a new C2 paradigm: centralized command, adaptive control, decentralized execution.[48] Rephrasing the master tenet helps in two ways. First, it encourages the flexibility of thought required to deal with an increased threat. Adaptive control will be necessary against a peer competitor because early phases will be centralized to halt escalation. If these efforts fail, increasing bandwidth disruption will necessitate C2 graceful degradation through the incremental decentralization of control. The elemental determinants can guide the commander in adjusting his level of control as ***depth of command*** shrinks. Secondly, rephrasing the 70-year-old master

tenet will signal the magnitude of the shift that is about to take place. It is strategic communication intended not only for Airmen, but to sister services as well. The new paradigm more closely aligns with joint doctrine's guiding C2 principle: "decentralized execution of centralized, overarching plans or via mission command."[49] The next step demonstrates the commitment to that principle.

Medium Term: Establish an Air Force Vision for Mission Command

As discussed above, adaptive control requires the USAF to raise its ***height of execution***. Joint Publication 1 states that mission command—decentralized execution based upon mission type orders—is the time-tested philosophy for empowering subordinates, "emphasizing trust, force of will, initiative, judgment, and creativity."[50] Marzolf and Fischer provide excellent arguments for why and how the concept should be implemented. The USAF must reconsider their recommendations and draft a vision for mission command that demands appropriate exercises, training, education, and doctrine.

Despite efforts to emphasize mission command's increased efficiency, the approach has gained little traction compared to other services due, perhaps, to the air component's higher barriers to entry. One such barrier is linked to the concept of coupling, or, the degree to which each element of a system affects the surrounding elements.[51] Although tightly coupled air, space, and cyber platforms must converge to accomplish a mission, they are rarely based together – a barrier to centralized planning. With no opportunity for a face to face mass briefing, force elements must collaborate through voice or network communication, a node that is now under threat.[52] Just because the transition to mission command is difficult does not mean the USAF should avoid it. The difficulty only makes it more likely that foes will exploit the

weakness. The final recommendation provides a long term development strategy for overcoming the barriers to entry.

Long Term: Leverage Overlaps in the Elemental Determinants for Cost-Conscious Force Development

Anthony Zolli defines the concept of adaptive capacity as "the ability to adapt to changed circumstances while fulfilling one's core purpose."[53] He describes patterns of resilience that aid adaptive capacity.[54] As opposed to a brute force method of plowing through the barriers to entry, the resiliency patterns offer a more elegant approach to enabling mission command. Some remove or weaken barriers while others maneuver around them. Figure 8 shows how four resiliency patterns can target the overlaps in the elemental determinants, encouraging a more cost-effective approach to raising the ***height of execution***.

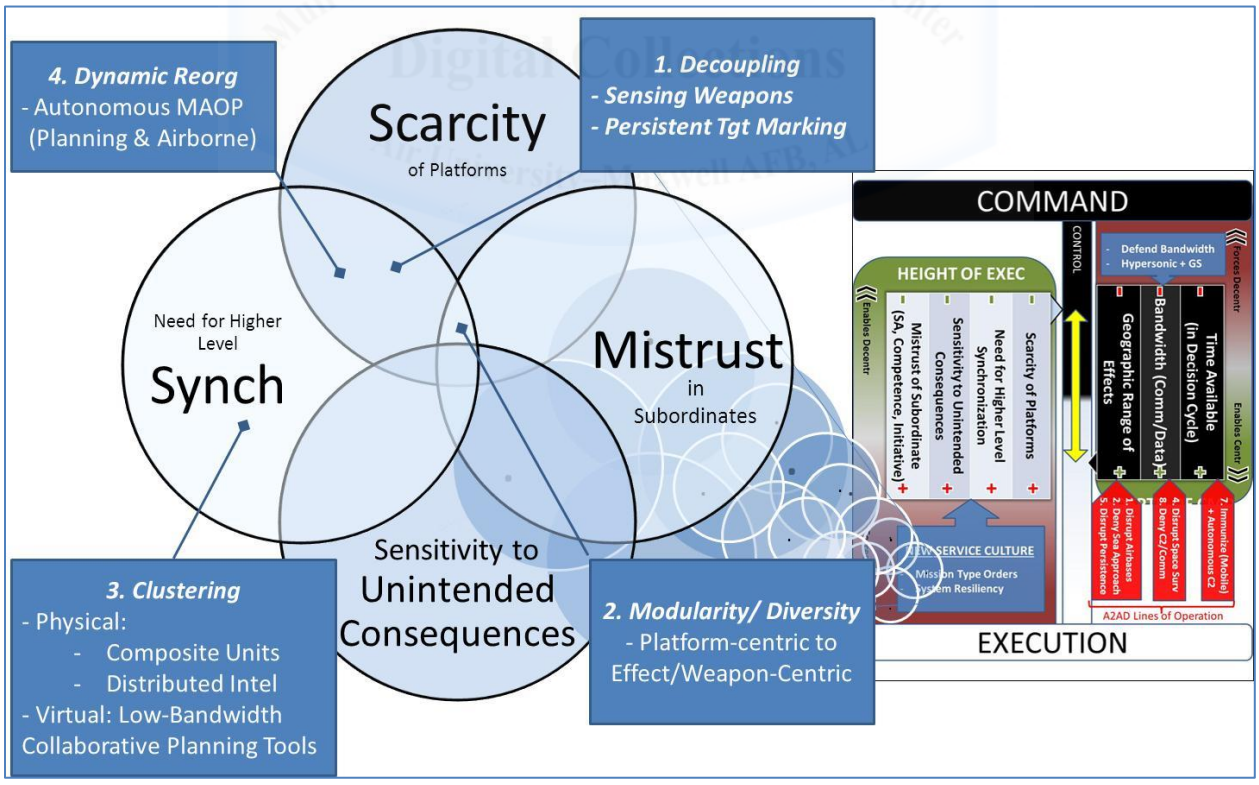

Figure 8: Resiliency-Based Approach to Enabling Mission Type Orders

In a bandwidth-denied environment, networks will connect as much as the threat allows. Instead of thinking in terms of back-up plans, begin by connecting from the bottom-up: establishing the minimum required information and building from there.[55] The resiliency patterns in Figure 8 are numbered according to the amount of connection required, then by the amount of overlap in the determinants. The discussion below examines the resiliency patterns in their depicted numerical order.

Decoupling improves resiliency by removing or reducing a system's dependence from its underlying material requirements.[56] Foster identifies the central A2/AD challenge is "maintaining sensor and weapon density at distance over time."[57] Two weapon concepts aim to get around the problem by removing the system's dependence on the underlying requirement of persistent sensors. The first concept is sensing weapons. The second is a persistent marking capability.

The USAF's time sensitive targeting process relies on a kill chain. As the saying goes, a chain is only as strong as its weakest link, and many links equals many potential weaknesses (and delays). Anti-access efforts in the information domain mean that sensors could have trouble talking to shooters. Weapons that sense for themselves, using multiple phenomenology to find, identify and track the desired targets on the way to a shoot container remove this link in the chain and relieve the requirement for persistent ISR.

The second approach involves retrofitting air and space based sensors with an ability to mark targets by applying a lasting inconspicuous signature modification. Various cross-domain platforms could launch the weapons from sanctuary and allow them to guide on the "smell" of the signature like a shark sensing blood in the water. The sensor could mark the target in phase zero, thereby reducing the need for persistent sensors in later phases.

The *decoupling* approaches offer relief for the central challenge of A2/AD and have the potential to boost three of the four elemental determinants. If the capability is proven in testing, it can reduce "mistrust in subordinates." These weapons reduce "scarcity of platforms" by improving the target per sortie ratio, and they decrease the "need for higher level synchronization" because they eliminate links in the kill chain and can be effectively launched outside of threat rings. Combining these decoupling concepts with modularity can provide a synergistic boost to the same three determinants.

Modularity, as Zolli describes it, has "components that plug into one another, much like Lego blocks, and—just as important—can unplug from one another when necessary."[58] It allows for system reconfiguration on the fly. For example, the ability to launch the weapons described above from as many platforms as possible would increase the available pool for re-rolling sorties due to fallout or losses. Modular air platforms build a more loosely coupled system which promotes decentralization.[59]

Clustering is bringing diverse, synergistic resources and talent together.[60] Fischer identified composite units and distributed intelligence as enablers for mission command.[61] His example of physical clustering reduces bandwidth and tactical communication requirements by allowing various aircraft types to plan and brief together.[62] Reestablishing the unit-level targeteer is another example of clustering talent that enables process ownership and improves trust in subordinates. A drawback to physical clustering is the increased vulnerability associated with placing all platforms in one place. Virtual clustering is an alternative that requires more connectivity. The USAF would need to develop low-bandwidth collaborative planning tools in order to support virtual clustering in a future peer fight.

Dynamic reorganization could take the form of autonomous master air operations planning (MAOP) software. Bounded by rules and constraints, this capability could not only shorten the Air Tasking Order cycle but could reorganize airborne packages as future aircraft log on to servers in a concept similar to fantasy football mock drafts or online poker rooms. This use of human-verified autonomy could reduce the "need for higher level synchronization" and lessen "scarcity of platforms" by improving the efficiency of sortie re-rolls.

Conclusion

In summary, prior to 2040, there will be technological peers who are focused on hitting the U.S. where it hurts the most. Other developing countries will use A2/AD as a blueprint, much like Mao's widely proliferated insurgency model. The lines of operation portend an ability to disrupt U.S. communications, forcing us to decentralize in order to maintain the initiative. The USAF must shed its cultural habits built from thirty years of air, space, and cyber supremacy. These present a barrier to clear thinking about future strategies. Joint doctrine recognizes the need for decentralization. Implementing the mission command concept is more difficult for the air component, but that is not a reason to wish away its necessity; all the more reason to prepare for an enemy that is sure to give no quarter.

The USAF must change its master tenet to read, "centralized command, adaptive control, decentralized execution." It must develop a vision for mission command. Finally, it must consider a resiliency-based force development strategy that overcomes the air-specific barriers to mission-type orders. This roadmap steers the USAF to adaptive control instead of hoping that brute-force network defense will hold against a determined technological peer. Hope is not a course of action.

Notes

(All notes appear in shortened form. For full details, see the appropriate entry in the bibliography.)

[1] Liang and Wang, *Unrestricted Warfare*, 125.

[2] Office of the US Air Force Chief Scientist, *Technology Horizons*, 58.

[3] Milan Vego warned in 2004, "the most serious current problem in the armed forces today is the over-centralized decision making on the operational and strategic levels." See Vego, "Operational Command and Control in the Information Age," 101.

[4] Joint Operational Access Concept, 28.

[5] Ibid.

[6] Ibid.

[7] AFDD-1 states "the goal is to maximize reachback [(leveraging communication to obtain products, services and applications from organizations that are not forward deployed)] and minimize forward presence as much as possible." See AFDD-1, 84.

[8] Joint Publication 3-30, I-3.

[9] B.H. Liddel Hart recognized this struggle for balance and the "duality" of the tension between centralization and decentralization: "Like a coin, it has two faces. Hence the need for a well-calculated compromise as a means to reconciliation." The Air Force has played out this struggle many times over its brief history. A key lesson for the senior airmen from World War Two (WWII) was that centralized control of air operations under one airman who understood airpower's unique range of effects was essential to maintain its inherent flexibility to mass forces quickly at a single point at critical times. This lesson centered on the fact that limited resources should not be assigned in penny packets to support ground commanders in stovepipes. Although penny packeting assured that each ground commander always had some small amount of airpower on hand, it did not make use of the aircraft's ability to quickly transfer from one area to another. In short, penny packing constrained air power's inherent flexibility to mass forces quickly at a single point at critical times. This was the origin of centralized control of air operations under one airman who understood its unique range of effects. See B. H. Liddell Hart, *Strategy*, 329; Hinote, *Centralized Control, Decentralized Execution*, 10; Joint Publication 3-30, I-3.

[10] Martin van Creveld, *Command in War*, 274.

[11] Hinote, *Centralized Control, Decentralized Execution*, 3.

[12] Joint Publication 1-02, 47.

[13] Hinote, *Centralized Control, Decentralized Execution*, 15.

[14] Stanton, Baber and Harris, *Modeling Command and Control*, 10.

[15] Alberts, *Understanding Command and Control*, 59.

[16] Joint Publication 1-02. Compiled by Electronic Search.

[17] Marzolf, "Command and Control of Airpower," 38.

[18] JP 3-01, V-14.

[19] The autonomous unit "assumes full responsibility for control of weapons and engagement of hostile targets in accordance with existing [rules of engagement], [weapons control status], and previously received directives."JP 3-01, V-14. ROE and WCS used in original; spelled out for clarity here.

[20] Marzolf, "Command and Control of Airpower," 41.

[21] Stanton, Baber, Harris, Modeling Command and Control, 233.

[22] Alberts, Hayes, Power to the Edge, 21.

[23] Kometer, Command in Air War, 16.

[24] This includes all aspects of doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF).

[25] Hinote, *Centralized Control, Decentralized Execution,* 64-65.

[26] Boyd, "Organic Design for Command and Control," slide 22.

[27] Alberts and Hayes, *Power to the Edge,* 19.

[28] Hinote, *Centralized Control, Decentralized Execution,* 9.

[29] Ibid., 61.

[30] Ibid., 61.

[31] Ibid., 60.

[32] Ibid., 60.

[33] Ibid., 62.

[34] Alberts and Hayes, *Power to the Edge,* 19.

[35] Vego, "Operational Command and Control in the Information Age," 100.

[36] Although the number of unmanned and propeller driven ISR platforms increased dramatically over the course of Operations Iraqi Freedom and Enduring Freedom, the number of platforms suitable for an opposed environment decreased.

[37] Although ground forces and MQ-1/9s provided cueing for many high value targets, neither source is likely to be survivable in a highly contested A2/AD environment.

[38] Kometer, *Command in Air War*, 74, 208.

[39] Prior to the mid-1990s, the Air Operations Centers exercised a more decentralized form of mission command, assigning targets to unit mission planning cells for determination of the optimal weapon/fuze pairing. This changed as the strategic consequences of collateral damage grew, visibility into logistics channels improved, and the ability to share large electronic files between the Air Operations Center and operational units advanced. As a result, the weaponeering function was centralized at the Air Operation Center. Eventually, the Air Force came to view unit-level targeteers as redundant and deleted the positions from unit intelligence

shops. In essence, the capability for parallel process weaponeering at the lower echelons was lost in this move.

[40]The People's Liberation Army (PLA) has a cadre of 30,000 cyber spies and 150,000 private sector cyber-reservists. They have mission-type orders to find vulnerabilities and "steal American military and technological secrets…" In April of 2009, U.S. government officials admitted to the cyber-theft of "several terabytes of data related to design and electronics systems."[40] Information and communications technology is listed as the greatest interest to foreign collectors because it "forms the backbone of nearly every other technology." Joel Brenner warns that even the highest classified networks are compromised[40] and the director of the National Intelligence Agency's information assurance directorate stated that the agency must assume that the most sophisticated intruders can operate on US networks undetected. Not only can the penetrations lead to espionage, they also enable offensive cyber operations. The congressional committee on U.S.-China Economic Security (USCC) reports that "Chinese cyber actors could place latent capabilities in U.S. software code or hardware components that might be employed in a potential conflict between the United States and China." China's growing cyber prowess plus her well-publicized anti-satellite efforts promise to disrupt C2 and slow down American decision making. See Brenner, 53; Gorman, Cole, Dreazen, 2011 Annual Report to Congress on Foreign Economic Collection and Industrial Espionage, ii; Brenner, 86; Reuters, "U.S. Code Cracking Agency Works as if Compromised," and U.S.-China Economic Security Commission, 2013 Annual Report, 258.

[41] In addition to the 2007 satellite shoot-down, in May of 2013, China fired a missile that appeared to be on a ballistic trajectory approaching geosynchronous Earth orbit. Such a capability not only threatens the GPS constellation, but would "allow China to threaten the U.S. military's ability to detect foreign missiles and provide secure communications." (2013 Annual Report. U.S.-China Economic Security Commission, http://www.uscc.gov/Annual_Reports, 219.

[42] The DoD's Defense Science Board warns that China has ramped up UAV and autonomous research faster than any other country in recent years, a development possible because China is "not constrained by many of the normal political processes found in democratic governments in the United States and Europe."[42] Known applications for her indigenous UAV's include ISR and communications relay, as well as electronic warfare and lethal missions. See Defense Science Board, U.S. Department of Defense, "The Role of Autonomy in DoD Systems," 70; and China's Unmanned Military Vehicle Industry, 3.

[43] Van Tol, *Air Sea Battle*, 11.

[44] Foster, "Joint Stealth Task Force," 48.

[45] Office of the US Air Force Chief Scientist. *Technology Horizons*, 101-103.

[46] Office of the US Air Force Chief Scientist. *Technology Horizons*, 79.

[47] Dietrick, Hypersonic Flight, 8.

[48] In his 2009 paper entitled "Command and Control of Airpower—A New Paradigm for the Future," Lt Col Marzolf recommended changing the master tenet to read, "Centralized Command, Adaptive Control, Decentralized Execution." See Marzolf, 37.

[49] Joint Publication 1, V-14.

[50] Ibid., V-15.

[51] Kometer, *Command in Air War*, 61.

[52] In the last two decades of conflict, this coordination has been doable, partly because air supremacy permits collaboration without detailed integration. Altitude deconfliction is often the only pre-mission coordination required and permissive tactical communications allow for airborne audibles and positive control from air battle managers. Additionally, cyber supremacy permits mission commanders to publish large power point presentations without the threat of compromise or denial. When air defenses fight back and networks are compromised, the requirement for detailed integration increases while bandwidth available decreases. Dynamic targeting is hard enough with air supremacy; it will be many times more difficult when all targets emerge post-takeoff and the sensor and shooter are under constant threat.

[53] Zolli, *Resilience*, 16.

[54] Ibid., 21.

[55] Harry Foster (Center for Strategic Air Studies), interview by author, 11 Feb 2013.

[56] Zolli, *Resilience*, 19.

[57] Foster, "Joint Stealth Task Force," 47.

[58] Zolli, *Resilience*, 19.

[59] Kometer, *Command in Air War*, 61.

[60] Zolli, *Resilience*, 21.

[61] Fischer, "Mission Type Orders in Joint Air Operations," 5.

[62] Ibid.," v.

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